THE MALE EFFECT ON SEASONALLY ANESTRUS BOER DOES

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ABSTRACT

The objective of this study was to determine if a male's presence had any effect on ovarian activity in Boer does and yearling does during summer anestrus. The buck's presence on first service conception rates was also recorded. Blood was collected from 17 mature Boer does and 9 yearling does via jugular venipuncture twice weekly from June 13, 2013 to August 22, 2013. Blood progesterone levels were assessed by the New Mexico State University Endocrinology Lab. After the collection period, females were turned out with a fertile buck for two cycles. Thirty five days following the second cycle, pregnancy was determined using ultrasound. It was concluded that introducing a buck prior to the breeding season is a viable method to stimulate anestrus does to begin cycling.

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INTRODUCTION

Seasonality of breeding has been an important issue for goat producers, not only because many of the holidays that routinely consume goat meat do not coincide with natural kidding dates, but also because producers of meat goats are limited to kids only being born a few short months out of the year, severely limiting marketing potential. Aside from "Spanish" goats, most other meat breeds, including Boer goats, exhibit periods of seasonal anestrus throughout the late spring and summer.

In the wild, seasonality served the purpose of ensuring that offspring were born when nutrition was optimal (Delgadillo et al., 2001), thus increasing the chances of survival (Price, 1985). Breeders in captivity are limited to manipulating the natural cycles of their does to induce estrus in the off season. This can be done using a variety of methods, but the two most common are using melatonin implants to mimic short day length (Zarazaga et al., 2009), and using a buck to induce ovulation (Flores et al., 2000; Delgadillo et al., 2002; Rivas-Muñoz et al., 2006; Bedos et al., 2010; Delgadillo et al., 2012).

With other livestock species (swine) the introduction of males stimulates a rapid response. Prepubertal gilts have been shown to achieve standing heat much sooner than gilts isolated from boars (Price, 1985). Some gilts begin cycling before the male even comes into direct contact with them. This indicates that male pheromones may play an important role in stimulating ovarian activity, along with physical male contact.

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With the ethnic demand for goat meat rising (Spencer, 2008), producers are in need of a cost efficient way to produce more kids during periods when kids are not usually born.

Melatonin implants have been proven to stimulate ovarian activity outside of the natural breeding season (Zarazaga et al., 2009), but the implants are much more costly than the presence of a male. The "male effect" may be a simple, cost effective method of manipulating seasonality in the doe.

OBJECTIVES

1. To determine the effects of male presence on the cyclicality of seasonally anestrus Boer does and yearling does.
2. To determine the effect of male presence on first service conception during the breeding season of Boer and yearling does.

LITERATURE REVIEW

Seasonal Variation and the Estrous Cycle of the Doe

Goats are considered to be short day breeders because the timing of their sexual activity begins in late summer when days begin to shorten, and ends again in spring when the amount of daylight increases (Zarazaga et al., 2009). Light detection by the retina relay neural messages to the hypothalamus via the suprachiasmatic nucleus. From the suprachiasmatic nucleus, light travels to the superior cervical ganglion. This initiates the postganglionic neurons to fire, which causes inhibitory neurons to make contact with the pineal gland. Pinealocytes secrete melatonin.

During daylight, inhibitory neurons fire continuously and inhibit the release of melatonin, but during periods of darkness the inhibitory pathway is shut down because the firing of the neurons has been reduced and melatonin can be released. Melatonin acts on the hypothalamus, causing it to secrete gonadotropin-releasing hormone (GnRH), which stimulates the production of luteinizing hormone (LH) and follicle stimulating hormone (FSH) in the anterior pituitary. Follicle stimulating hormone therefore causes the growth of the dominant follicle on the ovary while luteninzing hormone causes the follicle to erupt, beginning ovulation (Senger, 1997).

In other seasonally anestrus species (e.g., horses), an increase in melatonin corresponds with a decrease in GnRH, but in the case of the doe and ewe, an increase in melatonin stimulates an increase in GnRH. Ewes have been shown to continue folliculogenesis to the point of forming antral follicles during periods of anestrus. In a study conducted by Cahill and Maulèon (1980), it was found that there were no significant

differences between the number of active follicles in the harvested ovaries of ovariectomized ewes sampled mid- anestrus (June) and ewes sampled in December. There was also no significant difference between the number of atreic or dying follicles in December or June.

Similarly, the prolactin concentrations between Horned Dorsets, a lowly seasonal breed of sheep and Welsh Mountain, a moderately seasonal breed were nearly identical despite coming into estrus at different times of the year. Typically, prolactin is highest during the summer (Ortavant et al., 1985). Goats are perhaps even less anestrus than sheep; some "Creole" or "Spanish" breeds ovulate throughout the year, although fewer animals tend to display ovarian activity in July (Ortavant et al., 1985).

The Male Effect

The introduction of previously separated males to anestrus females is called the male effect, and it has been widely implanted in the sheep industry. Ovulation may be induced in as little as a few days after introduction, roughly 35 to 40 hours after exposure (Flores et al., 2000; Perkins and Fitzgerald, 1994). Female response can be divided into two parts: the initial response which is short term and characterized by rapid LH secretion and the beginning of estrous behavior, and the second response which is ultimately ovulation. The second response is long term and occurs later (Delgadillo et al., 2012).

In groups of seasonal polyestrus Muskox cows in Alaska, the cows that had early introduction to a bull came into estrus over a 7 day period versus the 12 day period of cows that had introduction during the normal breeding season (Rowell et al., 2003). Similarly, in short day breeding reindeer, cows exposed to a bull on August 23 displayed ovarian activity 16 days sooner than cows that were not exposed until September 25. The early exposure

cows also calved in a shorter interval than late exposure cows (Shipka et al., 2002). Among livestock species, high performing rams had initiated courtship behavior with 88% of ewes, and 95% of those ewes displayed signs of ovulation 24 days after initial exposure (Fitzgerald and Perkins, 1994).

Courtship behavior is defined as sniffing, foreleg kicks, vocalizations, the Flehmen response, and attempted mounting. The effectiveness of male exposure depends highly upon these sensory cues (Delgadillo et al., 2012; Price, 1985). Olfactory cues, however, are only successful in sexually experienced females, and naïve females generally fail to secrete LH in response to that particular cue. Likewise, vocalizations alone generally fail to stimulate response in studies that have implanted audio playback of male calls, perhaps due to editing of acoustics (Delgadillo et al., 2012). Intact bucks stimulate the greatest response in anovulatory females, although castrated males (wethers) may also be able to induce an LH surge if treated with an androgen, such as testosterone. Ovariectomized ewes have even been shown to work as effectively as rams if treated with testosterone (Walkden-Brown et al., 1997).

Climate and Reproductive Efficiency

An important issue in the reproduction of farm animals is external temperature. Increases in temperature cause a decrease in the preovulatory LH surge and also a decrease in progesterone in dairy cattle (Willard et al., 2003). Conception rates are generally lower in heat stressed cattle, and short cycles are more likely to be exhibited along with a failure to ovulate (Kornmatitsuk et al., 2008). The duration of estrus may also become shortened in response to rising temperatures (Price, 1985). Additionally, heifers raised in tropical

environments experienced puberty at a later date than heifers in moderate climates (Ortavant et al., 1985). In the ewe, sow, and cow, the effects of decreased fertility can be seen mainly as early embryonic death (Ortavant et al., 1985; Willard et al., 2003).

Prolactin and Lactational Anestrous

Anestrus in ruminants may be caused by a certain time of year, but it also can be caused by hormones secreted during lactation. Prolactin is a hormone that is secreted in the anterior pituitary and has some seasonal variation in sheep and goats; it is more commonly seen at increased levels in lactating animals. Prolactin stimulates the production of milk (NLM, 2009). In mammals, prolactin serves two purposes in terms of milk production: it stimulates the production of alveoli (the specialized cells that secrete milk), and along with insulin and cortisol, prolactin helps replicate the genes that code for milk production (Bowen, 20002). Prolactin is understood to suppress the production of GnRH, therefore preventing ovulation (NLM, 2009). The likelihood of anestrus due to prolactin is highest during early lactation, but ultimately it varies among species. In animals bred for milk production, lactational anestrus is fairly short, but in animals that nurse their young for longer period of time, the time spent not cycling may be greater (Hurley, 2010).

MATERIALS AND METHODS

Seventeen mature Boer does and nine yearling does were used in this experiment. The does were split into two groups with 13 animals in each group. The groups were stratified by age and randomly assigned to one of the two treatment groups. All of the does used were from the Angelo State University goat flock and the study was conducted at the Angelo State University Management, Instructional, and Research Center, located in San Angelo, Texas. All kids were weaned from the mature does at least 7 days prior to be beginning of the experiment. While all mature does were multiparous, some of the yearling does may have never kidded but all had experienced at least one estrus cycle. All procedures were approved by the Angelo State University Institutional Animal Care and Use Committee.

The two treatment groups were housed in two similar sized pastures with similar native vegetation at least 1 km away from one another to prevent buck exposure by the control does. A vasectomized Angora buck was introduced into the experimental group while the control group was removed from any physical, olfactory, visual, or audible male signals.

Due to accidental male contact, the control group was combined with the experimental group on August 8, 2013. From this date until the end of the study all females had exposure to the vasectomized buck and were housed together in a dirt lot. Animals had ad libitum access to water and sorghum hay, and were provided approximately .9 kg of a corn ration per head per day. Also at this time, does #246 and #247 were removed from the study due to declining health and poor body condition.

Blood samples were taken twice a week for approximately 9 weeks beginning June 13, 2013. Blood was collected every 3 to 4 days into serum separator tubes via jugular

venipuncture. Once collected, the blood was allowed to clot for roughly 30 minutes at room temperature before undergoing centrifugation to separate the plasma. Centrifugation lasted approximately 15 minutes at 1500 x g and 4℃ (Schneider and Hallford, 1996).

Following centrifugation, the samples were frozen at -20℃ and sent to the New Mexico State Endocrinology Lab to be analyzed for progesterone concentrations using radioimmunoassay as described by Schneider and Hallford (1996). Using the guidelines suggested by Schneider and Hallford, does that had a plasma progesterone concentration of 1 ng/mL or greater for at least two consecutive days had experienced an ovulation. These does were considered to be cycling and had displayed a functional corpus luteum (CL).

At the conclusion of the monitoring phase, does were placed with a fertile Boer buck during the normal breeding season (September 16th) of goats. The buck was fitted with a marking harness to monitor attempted breeding. Approximately 21 days after the first buck was introduced he was removed and a clean-up buck was put in for the remainder of the breeding season. Conception was determined via ultrasound approximately 35 days after the second buck was removed. Does were ultrasounded again 60 days later.

Data from this experiment was analyzed using a Chi-Square procedure in SAS (SAS Institute, Cary, NC). Treatments were considered different at a level of $p \leq 0.05$. Variables to be analyzed were pre fence cycles, cycles during entire evaluation period, 1st cycle conception rates, and kidding dates.

RESULTS AND DISCUSSION

The control group of does failed to exhibit estrus prior to the accidental fence line contact, while 25% (three out of twelve) of the experimental does had a functional CL (Table 1). There was not a difference in ovarian activity between the two groups before August 5, 2013. This is to be expected as the normal breeding season for Boer goats is late August until November.

After buck exposure, 66 % (8 out of 12 animals) of the control group displayed luteal activity while only the same three animals (388, 400, 390) had any rise in blood progesterone levels above 1.0 ng/mL in the experimental group (Table 2). This indicates that the experimental group may have become refractory to the vasectomized buck. It has been documented in ewes that experience a constant melatonin signal will eventually become unresponsive regardless of the season and enter a period of anestrus (Williams and Helliwell, 1993). The experimental does that failed to cycle likely became unresponsive to the unchanging courtship behaviors and pheromones of the Angora buck. It is very possible that if the buck has been removed and then reintroduced or another buck was introduced that luteal function may have resumed. In sexually satiated bulls, rams, and bucks, the presence of a novel female caused a rise in testosterone and LH; the same can likely be said for females as well (Loya-Carrera et al., 2014).

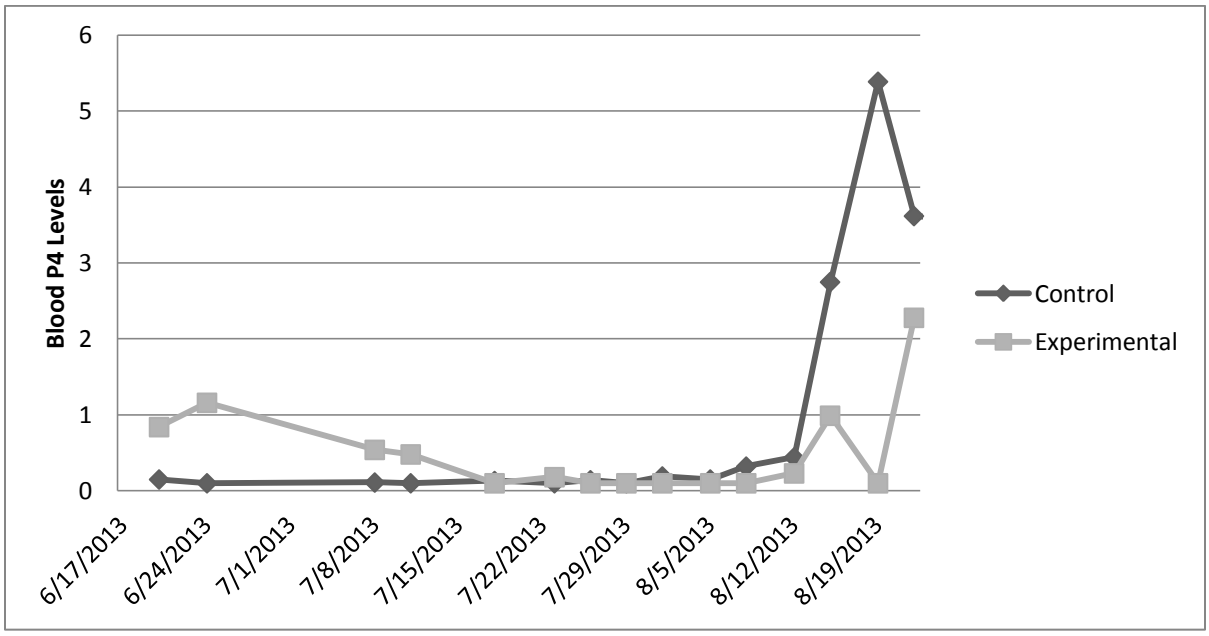
Another possibility for the lack of ovarian activity among the experimental does lies with the buck used. Of the three breeds of goats that could be accessed for this study (Boer, Angora, and Spanish), the Angora displays the lowest libido. This is exclusively the effect of generations of emphasis solely on Mohair production. Angoras are more highly seasonal than

Table 1. Variables selected for the hypothesis

	Treatment[a]	
	Control	Buck
N=	12	12
Cycle Pre Buck Exp[b]	0	3
Cycle Total Study[c]	8	3
1st Cycle Conception[d]	9	11

[a] :Animals were either assigned to control (no buck) or experimental (vasectomized buck) groups
[b]:Results prior to accidental buck exposure by control group
[c] :Results from entire study including accidental exposure and combination of groups
[d]:Conception in first fertile estrus during normal breeding season (late August-November)

Figure 1: Average progesterone levels throughout study



Spanish goats. Angoras are also unique in the fact that both sexes are seasonal (Shelton, 1993). Bucks typically show no sexual urge during spring and early to mid summer, perhaps due to a lack of stimulus from females (van der Merwe, 2012). Likewise, if no courtship behaviors (kicking, odor, vocalizations) were displayed by the buck, the does would be unlikely to ovulate.

A vasectomized Spanish buck may have been better suited for this study due to their lack of seasonality and higher sex drive and therefore a greater response from the females may have been detected. This idea is based on information from two does not included in this study. In early July, these two animals with 60 day old kids at their side were mounted by a Spanish buck that escaped from another ranch near the university ranch. During this same time, no goat on the study had any ovarian activity. In late December both non-experimental does delivered triplets.

Date of conception was determined from kidding date and 75% (9 out of 12) of the control does were successfully bred during the first fertile estrus of the breeding season. Does 361 and 358 failed to cycle during the evaluation period but conceived within the first 21 days of buck exposure based on the date they kidded. Three animals (308, 393, and 398), neither cycled during the study nor conceived on the first cycle, however 393 and 398 were confirmed pregnant via ultrasound. 308 was determined to be open on 4/1/14.

Among the experimental does, 92% of animals conceived during their first estrus with a fertile buck. Only 388 did not conceive, although she bred on the first day of her second estrus cycle. It should be noted that 388 displayed unusually high P4 levels for a prolonged period early in the study and then went anestrus for the duration of the testing period. This is very likely due to a cystic CL that eventually underwent lysis near the beginning of July. This is a possible explanation of her failure to breed on the first cycle.

IMPLICATIONS

Based on the results of this study, it was determined that using a buck is a cost effective way to induce cyclicity among anestrus Boer does. Producers must choose a buck with relatively high libido as does are most responsive to frequent courtship behaviors. For the greatest response, the buck must not be in a period of sexual rest himself, and therefore less seasonal breeds are the most effective. There is a possibility for the females to become refractory to a male's presence and more research is necessary, but introducing bucks for only a short period of time and then removing them may be more effective than leaving a buck with the does for an extended period of time.

A possible follow up to this study could include introducing a vasectomized buck two weeks prior to the desired breeding season. Based on data from this experiment, females should resume ovarian activity during those 14 days. The likelihood of breeding during the first estrus with a fertile buck is also greatly increased; therefore kidding would be sooner and over a shorter period of time.

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